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(54) Communication system with detection of extra-system interference

(57) A method of communication between two or more terminals (6, 7) with detection of interference, especially in a HiperLAN/2 system, comprising transmitting data between the terminals (6, 7) in electromagnetic signals of at least a first duration, the electromagnetic signals comprising one or more carrier frequencies within one or more ranges (1, 2) for which extra-system interference, especially with radar signals, is possible, at least one of the terminals (6, 7) being responsive to received signal strengths corresponding to intra-system interference (4, 17, 18). Detection of extra-system interference (5, 16) comprises at least one of the terminals (6, 7) responding selectively to received signal strengths that exceed a threshold level (19) for a second duration that is shorter than the first duration.

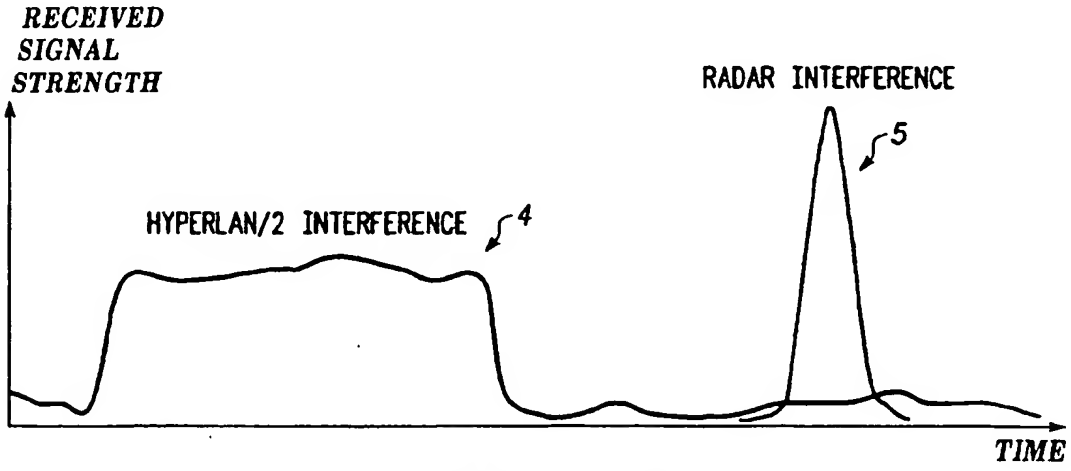

FIG. 2

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Description

Field of the invention

[0001] This invention relates to a method of and apparatus for communication between terminals with detection of extra-system interference, comprising transmitting data between said terminals in an electromagnetic signal comprising signal bursts.

Background of the invention

[0002] The invention is particularly applicable to radio communication in ranges of frequency where interference is likely between the communications and radar signals; however it will be appreciated that the invention is applicable in other situations also.

[0003] Interference with radar is a particular concern for communication according to the 'HiperLAN' standards of the European Telecommunications Standards Institute ('ETSI'), summarised in standard TR 101 683 V1.1.1 (2000-02).

[0004] The increasing demand for "anywhere, anytime" communications and the merging of voice, video and data communications create a demand for broadband wireless networks. ETSI has created the Broadband Radio Access Network ('BRAN') project to develop standards and specifications that cover a wide range of applications and are intended for different frequency bands. This range of applications covers systems for licensed and license exempt use.

[0005] HiperLAN/2 is a BRAN standard for a high speed radio communication system with typical data rates from 6 Mbit/s to 54 Mbit/s in a radio-linked local area network ('LAN'). It connects Mobile Terminals ('MT') - usually portable devices - with broadband networks that are based on Internet Protocol ('IP'), Asynchronous Transfer Mode ('ATM') or other technologies. Centralized mode is used to operate HiperLAN/2 as an access network via a fixed Access Point (AP) - the base station. In addition a capability for direct link communication is provided: this latter mode is used to operate HiperLAN/2 as an adhoc network without relying on a cellular network infrastructure and in this case a central controller (CC), which is dynamically selected among the portable devices, provides the same level of QoS support as the fixed access point. HiperLAN/2 is capable of supporting multi-media applications by providing mechanisms to handle Quality of Service ('QoS') adaptation. Restricted user mobility is supported within the local service area; wide area mobility (e.g. roaming) may be supported by standards outside the scope of the BRAN project. HiperLAN/2 systems operate in the 5 GHz band.

[0006] The frequency ranges allocated by the European Conference of Postal and Telecommunications Administrations. European Radiocommunications Committee are:

Frequency band RF	Power limit	Comments
5 150 MHz - 5 350 MHz	200 mW mean EIRP*	Indoor use only
5 470 MHz - 5 725 MHz	1 W mean EIRP*	Indoor and outdoor use

(* 'EIRP' = Equivalent Isotropic Radiated Power)

[0007] HiperLAN/2 systems have to be able to share the allotted frequency ranges with radar systems, some of which are mobile. This type of sharing requires dynamic adaptation - called Dynamic Frequency Selection (DFS) - to local interference conditions - a method that is also needed to facilitate uncoordinated sharing among HiperLAN systems.

[0008] A different (usually higher) degree of 'intra-system' interference (that is to say interference between two HiperLAN/2 devices) may be tolerated than for 'extra-system' interference (that is to say interference between a HiperLAN/2 device and a device of a different type of system, such as a radar device). Also, or alternatively, a different reaction may be required to intra-system interference than to extra-system interference.

[0009] Accordingly, it is desirable to be able to detect and distinguish between intra-system interference and extra-system interference; however, the detection and distinction is not perfect and it is desirable to minimise the incidence of false alerts. The current ETSI specifications do not provide suitable techniques for distinguishing between intra-system interference and extra-system interference.

[0010] More generally, other situations arise involving communication between two or more terminals where data is transmitted between the terminals in an electromagnetic signal comprising signal bursts and it is desired to detect extra-system interference (that is to say interference between a terminal of the communication system and a device of a different type of system) and distinguish it from intra-system interference (that is to say interference between two terminals of the same system that are not in direct communication).

Summary of the invention

[0011] The present invention provides a method of and apparatus for communication between terminals with detection of extra-system interference as described in the accompanying claims.

Brief description of the drawings

[0012]

Figure 1 is a schematic diagram showing the allocations of frequency spectrum in the 5GHz band by the European Conference of Postal and Telecommunications Administrations, European Radiocommunications Committee;

Figure 2 is a waveform diagram showing a received HiperLAN burst signal compared with a radar signal;

Figure 3 is a schematic diagram of a system comprising an access point and a mobile terminal in accordance with one embodiment of the present invention;

Figure 4 is a diagram showing samples of received signals including both intra-system and extra-system interference as detected in accordance with one embodiment of the present invention;

Figure 5 is a diagram showing samples of received signals including both intra-system and extra-system interference as detected in accordance with another embodiment of the present invention;

Figure 6 is a flow-chart showing steps of a method of detecting interference in accordance with an embodiment of the present invention; and

Figure 7 is a flow-chart showing steps of a method of distinguishing between intra-system and extra-system interference in accordance with an embodiment of the present invention.

Detailed description of the preferred embodiments

[0013] Referring first to figure 1, it will be seen that the HiperLAN/2 frequency ranges allotted by the European Conference of Postal and Telecommunications Administrations as shown at 1 and 2 are partly shared with radar, radio location frequencies occurring in range from 5250 to 5350 MHz and from 5650 to 5850 MHz, maritime and other radio navigation occurring in the range from 5460 to 5650 MHz and meteorological radar occurring in the complete band from 5250 to 5850 MHz, as shown at 3.

[0014] Different types of radar signals may be encountered. However typical characteristics are currently defined by three radar signals proposed by ETSI for testing HiperLAN/2 systems, as follows:

Radar signal type	Operating Frequency Range (MHz)	Band-width (MHz)	Burst Length (ms)/No. of Pulses per burst	Burst Interval (sec)	Pulse width (µs)	PRF (pps)	Interval between pulses (m-sec)	Antenna beamwidth / Scan rate (°/sec)
Basic test signal	> 5250	14	26/18	10	1	700	1.43	-/36
Meteorological	5600-5800	0.6	500/165	144	2	320	3	1.25/2.5
Maritime	5450-5820	2	5/10	2	0.2	1800	0.56	0.95/180

[0015] In HiperLAN communication, the signals are transmitted with orthogonal frequency division modulation ('OFDM') on a carrier, with several (64) sub-carriers, the signal transmitted (called a "burst" in the HiperLAN/2 specifications) having a minimum duration of eight microseconds, and the signals being grouped in frames of two milliseconds. Radar signals, on the other hand, consist of a repetitive series (called a "burst" in radar specifications) of pulses, the pulse width being typically less than two microseconds.

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[0016] The difference between the signal durations of a HiperLAN/2 signal 4 and a typical radar pulse 5 received at a HiperLAN terminal is shown in figure 2. The HiperLAN/2 signal will be intra-system interference if the signal is not intended for that terminal and the radar signal 5 is always extra-system interference.

[0017] Figure 3 shows schematically a HiperLAN/2 system in accordance with the present invention. The system comprises a plurality of access points, one of which is shown at 6, and a plurality of mobile terminals, one of which is shown at 7. The access point 6 comprises a signal source 8, a signal processor 9, radio frequency circuits 10 and an antenna 11. The mobile terminal 7 comprises a signal source 12, a signal processor 13, radio frequency circuits 14 and antenna 15.

[0018] In operation, data from the signal source 8 of the access point 6 is sent to the signal processor 9, which encapsulates the data and sends it to the RF circuits 10. The RF circuits 10 modulate the data on a carrier frequency for transmission from the antenna 11. During reception, signals received on the antenna 11 are demodulated in the radio frequency circuits 10 and passed to the signal processor 9.

[0019] In operation of the mobile terminal 7, during reception, signals received at the antenna 15 are demodulated in the radio frequency circuits 14 and sent to the signal processor 13. During transmission, data from the signal source 12 is sent to the signal processor 13, which encapsulates the data and sends it to the RF circuits 14. The RF circuits 14 modulate the data for transmission from the antenna 15.

[0020] During a start-up phase, when the access point is switched on, it initially measures signals received at the antenna 11 within its allotted frequency ranges to check for interference. The signal processor 9 contains a stored list of the discrete frequencies allotted within the HiperLAN/2 frequency ranges. If interference is detected on a given frequency, that frequency is marked as unavailable in the memory of the signal processor 9. Normal operation begins after the start-up phase with transmission of a signal from the access point 6 at a frequency that is not marked as unavailable.

[0021] The mobile terminal 7 has an active phase and a passive ("sleep") phase. The signals transmitted from the access point 6 include both communication data signals and functional data signals, the functional data signals including an identification of the mobile terminal 7 that is addressed. In the passive state, the mobile terminal 7 is responsive only to the functional data signals, circuits that process the communication data signals being shut down in order to conserve battery power. Reception of a functional data signal that includes the relevant identification of the mobile terminal 7 triggers response of the terminal 7 to the communication data.

[0022] The access point 6 is normally a fixed terminal whereas the mobile terminal 7 may be a portable terminal. The access point 6 will not necessarily detect interference at the position of each mobile terminal such as 7. Also, the access point 6 may be masked from interference, especially if it is situated indoors, whereas the mobile terminals such as 7 may be more likely to be exposed to and to cause interference if they are situated out of doors. To improve detection of interference and avoidance of causing interference, the mobile terminals 7 are also arranged to detect interference. To this end, the access point 6 is arranged to send a function control signal triggering response of the mobile terminal 7 to received signal strength on its antenna, to which the mobile terminal 7 responds by reporting the detected interference back to the access point 6, as described in more detail below.

[0023] Intra-system interference occurs when a mobile terminal 7 receives signals that are not intended for it, either from a different access point 6 than its current home access point or from another mobile terminal 7 with which it is not intended to be in communication. Extra-system interference originates from devices not forming part of the HiperLAN system and, in particular, from radar systems.

[0024] In the case of HiperLAN/2 intra-system interference, an access point such as 6 that detects the intra-system interference will respond by changing its communication frequency, after transmitting information to its associated mobile terminals such as 7 as to the new frequency, so that the mobile terminals 7 also change frequency. The dynamic frequency selection is reciprocal, that is to say that access points such as 6 that are transmitting tolerate a certain level of interference but any access point 6 that is receiving changes frequency if necessary in the event of intra-system interference.

[0025] In the case of extra-system interference, however, such reciprocity does not exist. Interference with a radar system, especially, is to be reduced as far as possible and the radar system will not react to avoid interference with the HiperLAN system. Accordingly, it is important for the HiperLAN system to detect radar signals on a given frequency and change communication frequency, not only to improve HiperLAN communication, but also especially to avoid the HiperLAN signals interfering with the radar system.

[0026] Referring now to figure 4, in this embodiment of the present invention, the detection of interference at both the access point 6 and the mobile terminal 7 is based upon sampling the received signal strength at the antenna 11 or 15. The sampling is made at intervals of x microseconds continuously, so that each sampling period is also x microseconds long. The received signal strength is averaged over the duration of the sampling period. Accordingly, if a brief pulse is received during the sampling period and the duration x of the sampling period is too long compared to that of the received pulse, the average value measured will be relatively low and detection will be more difficult. Measurement over a continuous series of sampling periods enables the duration x of each sampling period to be reduced

and detection levels to be improved without risk of missing a radar pulse between two non-consecutive sampling periods.

[0027] Normally, levels of interference will be lower than normal received signal levels from and to the home access point and other mobile terminals such as 7 in the same cell. Accordingly, detection of interference will be less sensitive during periods when communication signals are being received. It is considered unacceptable to halt all traffic in the cell during normal operation in order to detect interference. However, during normal operation, empty spaces are available, or may be made available, during unused parts of the frames of the HiperLAN/2 communication signals and, in this embodiment of the invention, checking for extra-system interference is performed during these empty spaces. These empty spaces are indicated for each frame in the frame channel information element of the HiperLAN/2 function data signals.

[0028] The received signal strength of a radar pulse during a sampling period is shown at 16 in figure 4, for a radar pulse shorter than or equal to x microseconds. Figure 4 also shows the received signal strength of HiperLAN/2 signals at 17 and 18, the HiperLAN/2 signals extending over several sampling periods with relatively constant signal strengths, to within $\pm\Delta$, apart from an initial and final sampling period.

[0029] In accordance with this embodiment of the present invention, the HiperLAN/2 terminal detects whether the number n of samples for which the received signal strength exceeds a radar threshold 19 is greater or lower than a minimum duration corresponding to N samples. The duration of N samples, that is to say N*x microseconds, is chosen to be longer than the maximum expected duration of a radar pulse and shorter than the minimum duration of a HiperLAN/2 signal. By way of example, the minimum duration of a HiperLAN signal being eight microseconds, in this embodiment of the invention the sampling interval x is chosen to be two microseconds and the value of N is chosen to be three. Received signal strength greater than the radar threshold 19 for more than three sampling periods is assumed to correspond to HiperLAN/2 intra-system interference (and not to a HiperLAN/2 communication signal of the same cell) since the signal is received during an unused space in the HiperLAN/2 frame. A received signal strength exceeding the radar threshold 19 for three samples or less is assumed to be a radar signal. Figure 5 shows the case of a radar signal that extends over three sampling periods.

[0030] It is important to reduce the incidence of false alerts, as these perturb the proper functioning of the HiperLAN/2 system. Accordingly, the data for interference detection performed by a plurality of mobile terminals such as 7 is communicated to the access point 6, which collates the responses from the different mobile terminals such as 7 and deduces the presence of radar interference only if the data from more than one terminal (both mobile terminals and the access point itself) indicates detection. The minimum number of detections required is a function of the number of mobile terminals performing the extra-system interference detection routines. Interference detection by the mobile terminals occurs during unused spaces in the HiperLAN/2 frame, so that reports cannot be transmitted back from the mobile terminals to the access point 6 immediately but are stored for subsequent transmission; this also enables data to be transmitted back to the access point 6 for detections made two or more unused spaces, which are not necessarily consecutive in the frame.

[0031] Referring now to figure 6, detection of extra-system interference is separate from the "percentile measurements on used frequency" specified for HiperLAN/2 dynamic frequency selection for intra-system interference, which will not be described in the present specification, and which is conducted in parallel with the process illustrated in figures 6 and 7. Extra-system interference detection starts with a request in the function control signals from the AP, at 20, instructing mobile terminals such as MT_1, MT_2 and MT_n to perform the radar detection routine, the request including the identifications of the chosen mobile terminals and designating empty spaces in the frame for the detection. As shown at 21, the access point 6 itself may equally perform radar detection during the same empty spaces, being free to communicate with the mobile terminals during other spaces in the frame. At 22, if the function control signal from the access point 6 requires detection by that mobile terminal to continue, the mobile terminal continues and, if not, the mobile terminal stops detection and reverts to normal operation at 23.

[0032] When detection is required, the mobile terminal 7 samples the received signal strength continuously at the sampling period interval during a given empty space, being free to communicate with the access point 6 or other mobile terminals such as 7 during the other spaces. The mobile terminal processes the samples at 25, the process sequence being illustrated in figure 7. The results of the sampling and processing are transmitted to the access point 6 by each of the mobile terminals that performed detection only if extra-system interference was detected at that mobile terminal. The access point 6 collates the samples received at 26, and interprets whether more than one mobile terminal had detected extra-system interference. If not, the access point reverts to normal operation and indicates to the mobile terminals such as 7 to revert to normal operation also, as shown at 27.

[0033] On the other hand, if the access point 6 concludes that a radar signal was detected, the access point registers that frequency as unavailable at 28 and, at 29, decides whether to check another frequency before changing communication frequency or to change communication frequency and check interference subsequently. In the former case, the cycle reverts to requesting interference detection, at 20, and in the latter case the communication frequency is changed first, at 30.

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[0034] Figure 7 shows the routine 25 of processing the samples in the mobile terminals. The access point 6 may follow a similar routine for processing its own samples. The received signal strength of the frame is measured during each sample period in the same unused space and the mobile terminal compares the sample with the radar detection threshold 19 at 31. If the sample is less than the threshold 19, the mobile terminal passes to the next sample in the same space at 31. If the received signal strength of the sample exceeds the threshold 19, the time stamp and value of the sample is registered at 32.

[0035] At 33, if the sample detected is not the first sample detection exceeding the radar threshold, a sub-routine follows which is intended to reduce the incidence of false alerts due to two HiperLAN/2 interference signals that are partially coincident during one or more sampling periods, while recognising a radar signal that is partially coincident with at least a single HiperLAN/2 interference. At 34, the value of the current sample is compared with the value of the initial samples in the current unused space. If the interference is HiperLAN intra-system interference, the subsequent samples will normally be within $\pm\Delta$ of the initial samples. In the preferred embodiment, the third and subsequent samples are compared with the average of the values of the first two samples rather than a single value, to reduce the risk of error.

[0036] If the current sample is closer than $\pm\Delta$ to the initial samples, a counter n_1 is incremented at 35. If the current sample is not closer than plus or minus delta to the initial samples, but is lower, it is assumed that the current sample does not correspond to radar interference but that the previous samples may do. Counter n_1 is therefore not incremented and the routine passes to the next step 38. If the current pulse is greater than previous samples $+\Delta$, however, it is assumed that the previous samples corresponded to HiperLAN interference and the current sample may correspond to radar interference. Counter n_1 and also a counter n_2 are therefore incremented at 37.

[0037] The first sample detection exceeding the threshold will inevitably not be within $\pm\Delta$ of previous samples. Accordingly, at 33, if it is the first detection in that space, the counter n_1 is incremented directly, at 35.

[0038] At 38, the mobile terminal checks whether the current sample corresponds to the end of the current empty space; if not it passes to the next sample at 31 and if it does correspond to the end of the empty space, it checks the values of the counters n_1 and n_2. At 39, the mobile terminal checks whether n_1 is greater than N; if not, it is assumed that a radar interference has been detected and the report is stored for subsequent reporting to the access point 6. If n_1 is greater than N, n_2 is checked relative to N at 40. If n_2 is less than N, the assumption that a radar interference has been detected is stored for reporting to the access point 6; if n_2 is also greater than N, it is assumed that neither n_1 nor n_2 correspond to detection of radar interference.

[0039] In both cases, the counters n_1 and n_2 are then reset at 42. When the reports are to be sent to the access point 6, the mobile terminal checks at 43 whether radar was detected and, if so, sends the reports at 44 and the routine ends at 45; otherwise, the routine ends immediately after 43.

[0040] It should be noted that, in the case of intra-system interference, radar interference will often come from fixed installations that can be expected to last for a long period. Although the disturbance to normal communication has been reduced as far as possible in the radar interference detection routines, it is still desirable to reduce the repetition of communication of the detection results and changes of frequency as far as possible. Accordingly, unlike dynamic frequency selection in the case of intra-system interference, the unavailable frequencies registered at 28 are stored in the access point 6 for several hours and preferably for several days. The detection routine is still performed more frequently, but the likelihood of again using a frequency used by the same radar is reduced.

[0041] The access point 6 decides how many and which mobile terminals are to perform measurements at the same time. The more mobile terminals perform detection of extra-system interference at the same time, the lower the probability of false alarm will be and the higher the probability of correct detection will be. However, in this embodiment of the invention, the access point 6 does not involve mobile terminals that are currently in the passive ("sleep") mode of operation.

[0042] The value of the detection interval x is a matter of choice. The preferred value is two microseconds, and in practice it is preferred to choose intervals exceeding 600 nanoseconds at least, even though hardware would allow shorter intervals.

[0043] The choice whether to check other possible future communication frequencies before changing the communication frequency as at 29 is partly influenced by the switching time of mobile terminals to receive the instruction to change frequencies and execute it. In this embodiment of the invention, the available frequencies are checked rapidly without changing communication frequency at a period just after the start-up of the access point 6, in order to detect as rapidly as possible meteorological radar whose beam rotation rate is slow.

[0044] In the preferred embodiment of the invention, a terminal receiving a communication signal (whether a mobile terminal 7 or an access point 6) during used spaces in the frames also performs estimates of the interfering received signal strength during each OFDM symbol. An estimate of this kind is available every four microseconds. This estimate is compared to a threshold giving an approximate indication whether the interference arises potentially from radar. The threshold is typically different from the threshold 19 and is chosen as a function of the expected signal strengths.

[0045] In this embodiment of the invention, for each processed OFDM symbol the complex values of every pilot subcarrier are extracted. An estimate of the complex noise is obtained by subtracting the product of the channel estimate

given by the transmitted pilot from the received pilot signal strength. The channel estimate is obtained at the beginning of the HiperLAN/2 signal and is required for normal OFDM processing in any case. The average of the noise estimates is compared with the threshold and more accurate power measurements during unused spaces as described above are scheduled during future frames by the access point 6.

[0046] During the start-up phase, in the preferred embodiment of the invention, the access point 6 itself checks for interference on all frequencies it is permitted to use, in accordance with the HiperLAN/2 standards. According to the current standards, the access point 6 is able to choose the frequency with the lowest intra-system interference. In the present embodiment of the invention, however, the initial communication frequency is selected from a subset of the total available frequencies, the chosen frequency being the frequency within the subset that has the least intra-system interference. The subset of frequencies is stored in the memory of the access point 6 and corresponds to the range from 5150 MHz to 5250 MHz, where radar interference is not expected. If intra-system interference is detected on the first frequency of the subset selected, the communication frequency is changed to another frequency of the subset, unless all the frequencies of the subset are registered as interfered (and therefore unavailable), in which case a frequency from outside the subset is chosen.

[0047] During the start-up period, the access point 6 is free to detect radar interference from a simplified routine as no communication with the mobile terminals is yet established. The period of this detection is reduced in the preferred embodiment of the invention, to avoid inconvenience to the user when the access point 6 is started up. In order to ensure that radar interference from meteorological radar, for example, whose repetition rate is slow is properly detected, the detection routines shown in figures 6 and 7 involving the mobile terminals are started immediately after the start-up phase.

Claims

1. A method of communication between at least two terminals (6, 7) with detection of interference, comprising transmitting data between said terminals (6, 7) in electromagnetic signals of at least a first duration, said electromagnetic signals comprising one or more carrier frequencies within one or more ranges (1, 2) for which extra-system interference is possible, at least one of said terminals (6, 7) being responsive to received signal strengths corresponding to intra-system interference (4, 17, 18),
   characterised in that detection of extra-system interference (5, 16) comprises at least one of said terminals (6, 7) responding selectively to received signal strengths that exceed a threshold level (19) for a second duration that is shorter than said first duration.

2. A method of communication as claimed in claim 1, wherein detection of intra-system interference comprises responding selectively to received signal strengths exceeding a first threshold level, and said detection of extra-system interference comprises responding selectively to received signal strengths that exceed a second threshold level (19) lower than said first threshold level for said second duration.

3. A method of communication as claimed in claim 1 or claim 2, and comprising a first reaction to detection of said intra-system interference and a second, different reaction to detection of said extra-system interference.

4. A method of communication as claimed in any preceding claim, wherein said carrier frequency is changed in response to detected interference.

5. A method of communication as claimed in claim 4, wherein said carrier frequency is selected from a plurality of discrete carrier frequencies whose availability is stored in at least one of said terminals (6, 7), the corresponding frequency being registered as unavailable (28) and said carrier frequency being changed to a different frequency at least in response to detection of extra-system interference (5, 16).

6. A method of communication as claimed in claim 5 wherein, at least during a start-up phase, said carrier frequency is initially selected from a sub-set of said plurality of discrete carrier frequencies and is changed to another available frequency of said sub-set in response to detected interference unless all frequencies of said sub-set are registered as unavailable.

7. A method of communication as claimed in any preceding claim, wherein said received signal strengths are sampled in a succession of sampling periods (16, 17, 18), and said detection of extra-system interference (5) comprises responding selectively to received signal strengths that exceed said threshold level for not more than a limited number (N) of said sampling periods (16) in the same succession of sampling periods.

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8. A method of communication as claimed in claim 7, wherein detecting extra-system interference (5) comprises responding selectively if the received signal strength exceeds signal strengths previously sampled in the same succession of sampling periods (17, 16, 18) by more than a minimum variation ($\pm\Delta$) for not more than a limited number (N) of said sampling periods.

9. A method of communication as claimed in any preceding claim, wherein said signal comprises repetitive frames, each frame comprising a plurality of spaces for said data, and said detection of interference comprises responding to received signal strengths that exceed said threshold level during spaces that are unused for said data.

10. A method of communication as claimed in claim 9 wherein, while said at least one terminal is receiving, it is responsive to noise levels that exceed a noise threshold level during spaces that are used for data to trigger said interference detection during spaces that are unused for data.

11. A method of communication as claimed in any preceding claim, wherein said terminals include an access point (6) and at least one further terminal (7), said access point (6) having communication links with at least one network with which said further terminal (7) may communicate through said access point, said further terminal (7) being responsive to said received signal strengths to transmit to said access point (6) an indication of detection, and said access point (6) being selectively responsive to reception of said indication of detection.

12. A method of communication as claimed in claim 11, wherein said access point (6) is selectively responsive to detection of interference by a plurality of said terminals (6, 7).

13. A method of communication as claimed in claim 11 or claim 12, wherein said access point (6) transmits a function control signal to said further terminal (7) to trigger response of said further terminal to said extra-system interference.

14. A method of communication as claimed in claim 13, wherein said signal comprises repetitive frames, each frame comprising a plurality of spaces for said data, said function control signal designating spaces in said frames as unused for data, and said further terminal being responsive to received signal strengths that exceed said threshold level during the designated unused spaces.

15. A method of communication as claimed in claim 13 or claim 14, wherein said access point (6) is responsive to detection of interference to transmit a function control signal to said further terminal (7) to trigger response of said further terminal to said extra-system interference.

16. A method of communication as claimed in any of claims 13 to 15, wherein said further terminal (7) has an active mode of operation in which it is responsive to said communication data and to said function control signal and a passive mode in which it is responsive to said function control signal but not to said communication data, and said access point (6) transmits a function control signal to said further terminal (7) to trigger response of said further terminal to said extra-system interference conditionally upon said further terminal being in said active mode.

17. A method of communication as claimed in any preceding claim, wherein said one or more ranges (1, 2) of carrier frequencies include frequencies (3) attributed to radar signals and said detection of extra-system interference comprises responding to reception of radar signals.

18. A terminal for communication and detection of extra-system interference by a method as claimed in any preceding claim.

19. A system for communication and detection of extra-system interference by a method as claimed in any of claims 1 to 17, comprising said at least two terminals (6, 7).

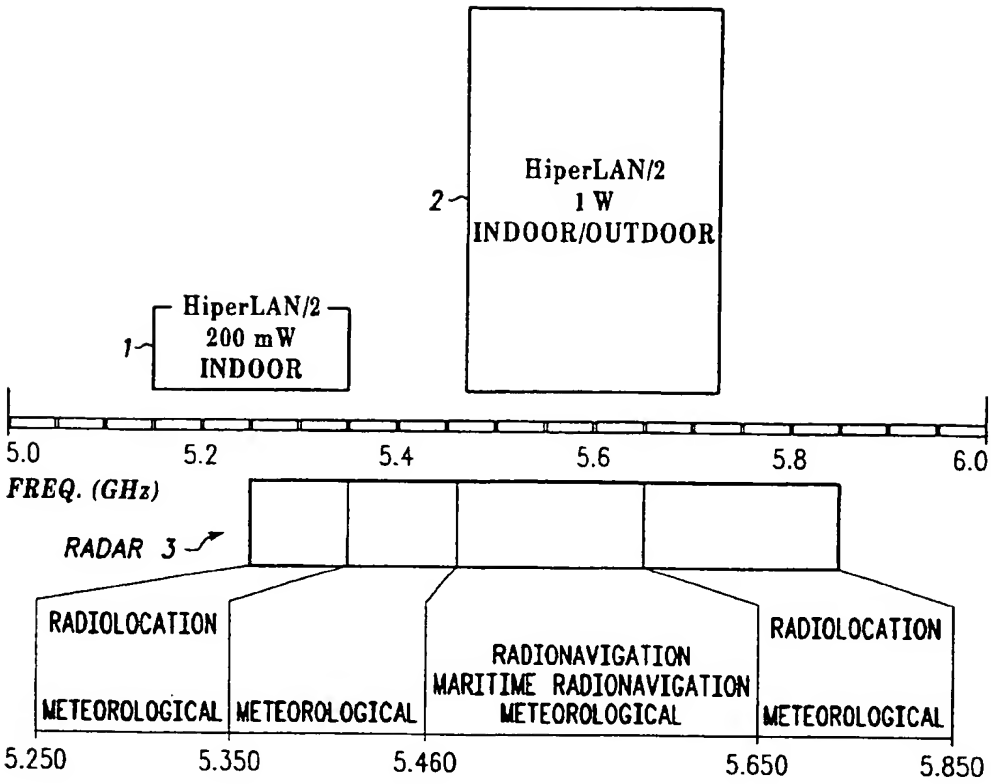

FIG. 1

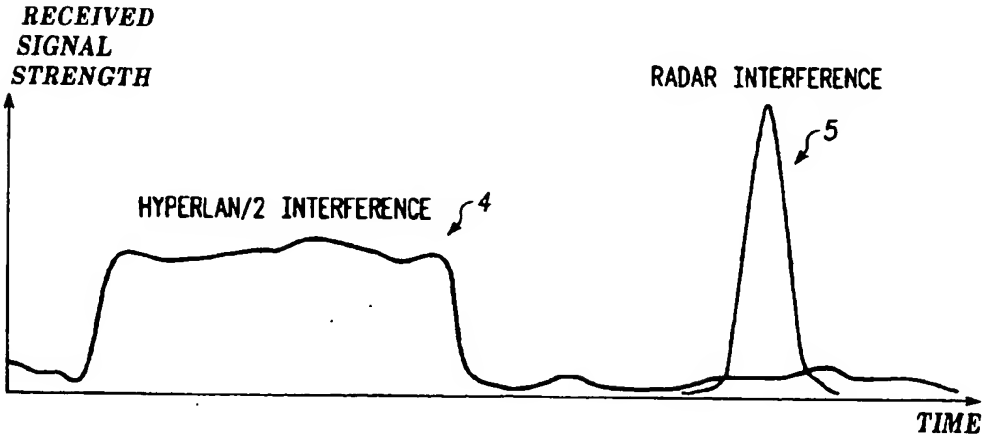

FIG. 2

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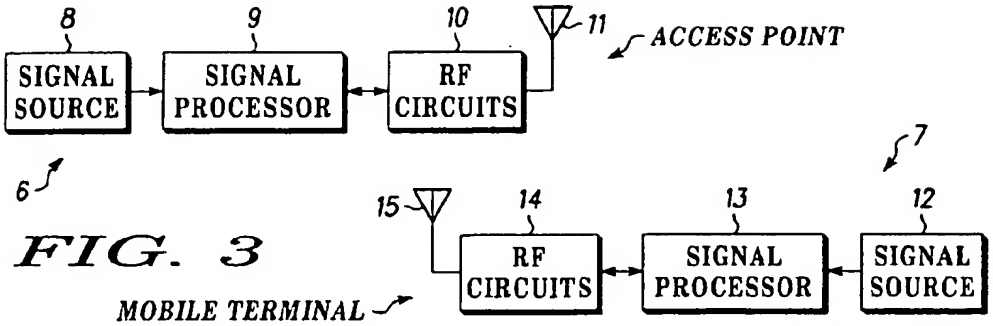

FIG. 3

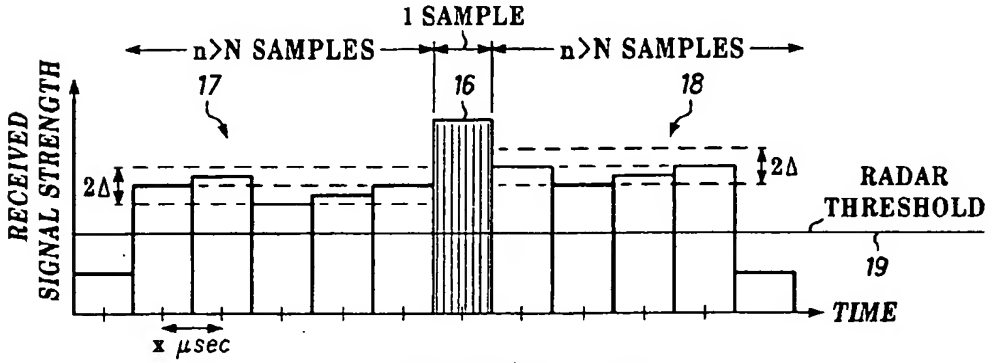

FIG. 4

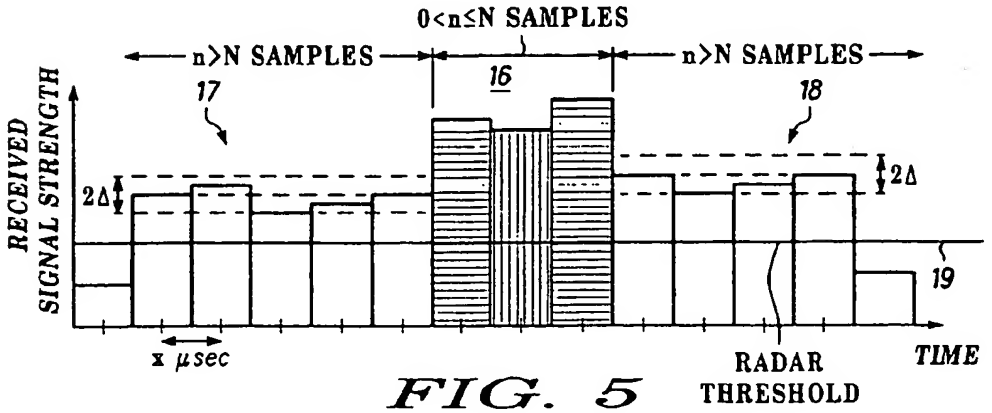

FIG. 5

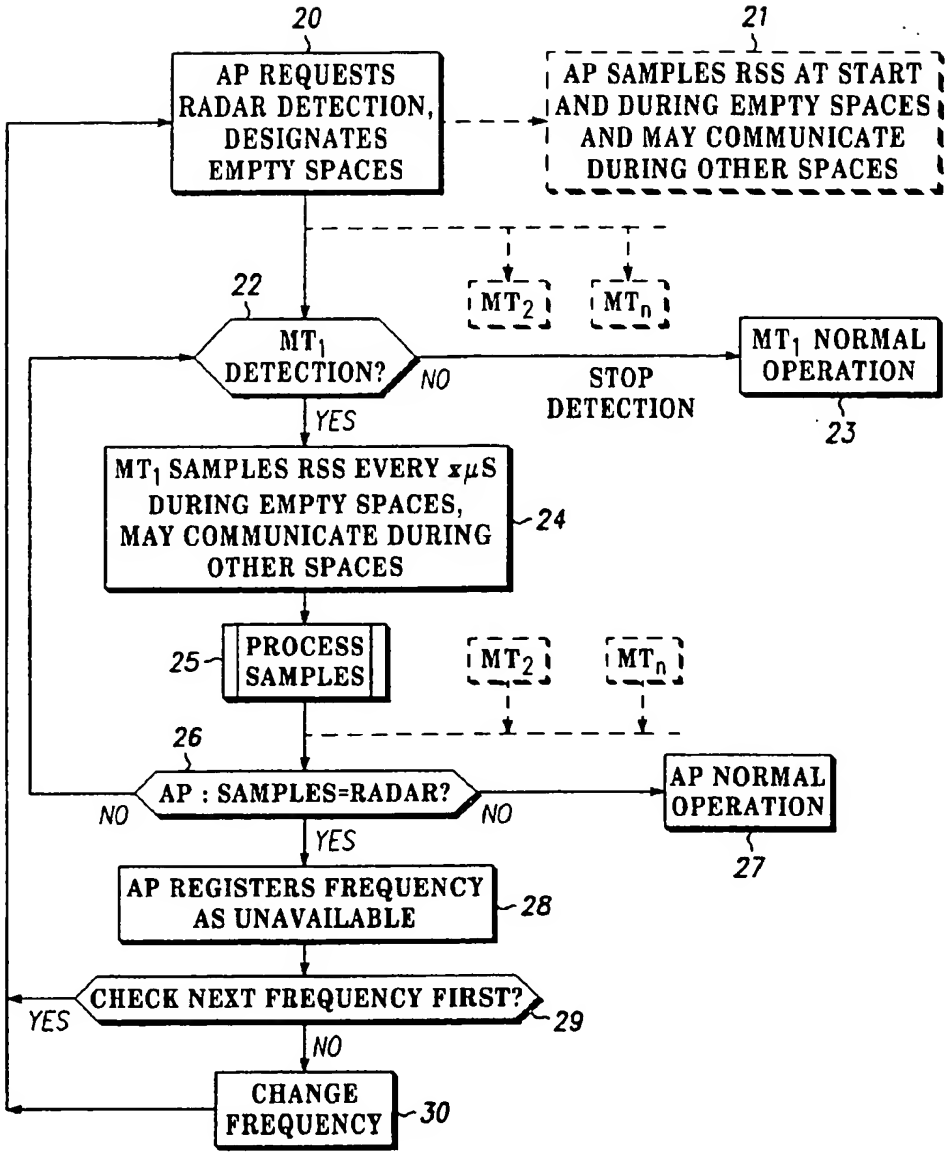

FIG. 6

BNSDOCID: <EP_____1298949A1_I_>

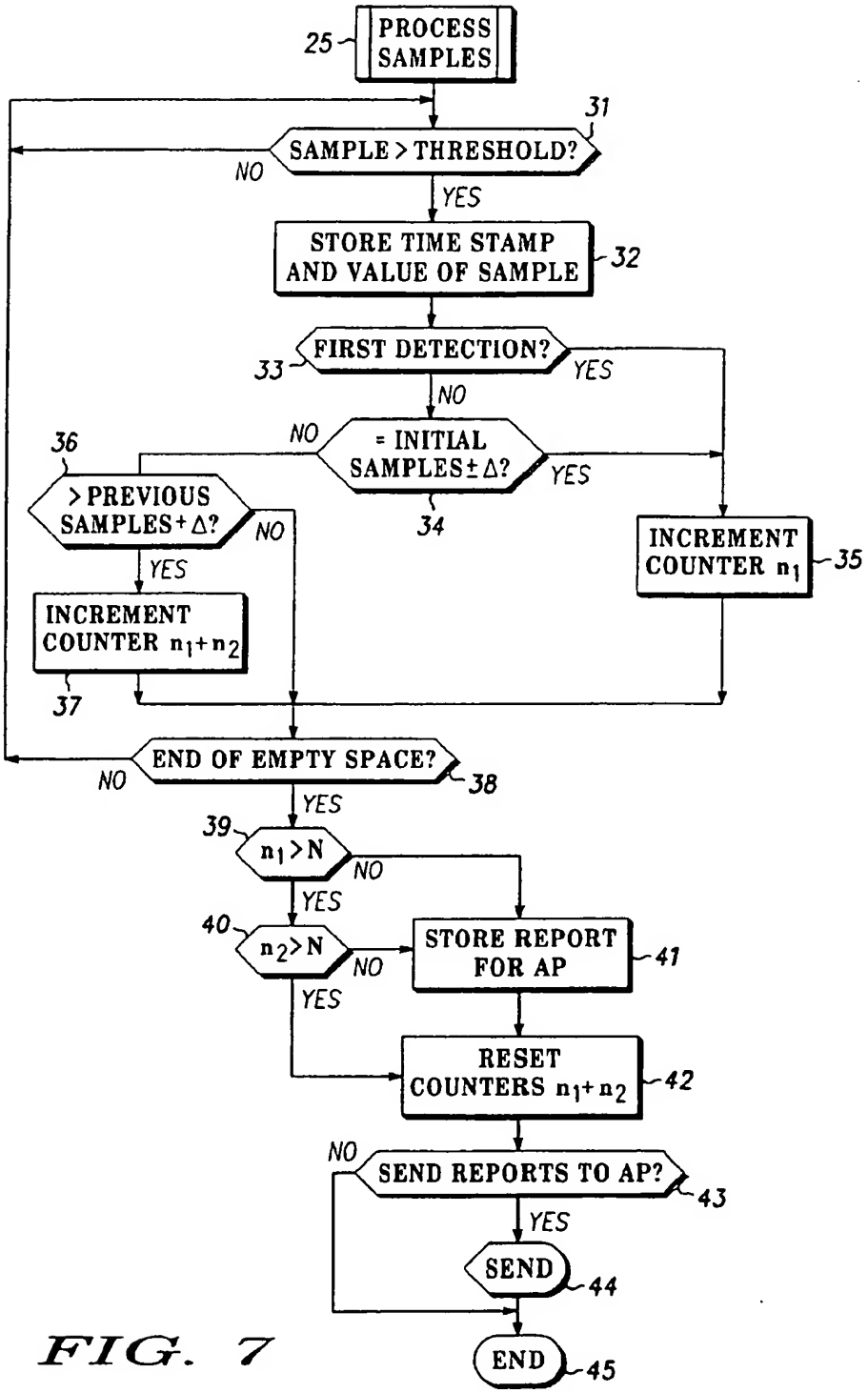
25
PROCESS SAMPLES
31
SAMPLE > THRESHOLD?
NO
YES
STORE TIME STAMP AND VALUE OF SAMPLE
32
33
FIRST DETECTION?
YES
NO
36
NO
= INITIAL SAMPLES ± Δ?
YES
34
> PREVIOUS SAMPLES + Δ?
NO
YES
INCREMENT COUNTER n_1
35
INCREMENT COUNTER n_1+n_2
37
END OF EMPTY SPACE?
NO
38
YES
39
$n_1 > N$
NO
YES
40
$n_2 > N$
NO
STORE REPORT FOR AP
41
YES
RESET COUNTERS n_1+n_2
42
NO
SEND REPORTS TO AP?
43
YES
SEND
44
END
45

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 40 2507

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 752 164 A (JONES J BARCLAY) 12 May 1998 (1998-05-12) * column 2, line 16 - line 51 * * column 8, line 51 - line 57 * * column 10, line 23 - line 25 * * table II * * column 12, line 40 - line 41 * * column 18, line 38 - line 40 * * column 26, line 11 - line 15 *	1-6, 11-13, 15,17-19	H04Q7/38 H04L27/26 H04B1/38
X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 25, 12 April 2001 (2001-04-12) & JP 2001 237846 A (NIPPON TELEGR & TELEPH CORP), 31 August 2001 (2001-08-31) * abstract *	1-6, 11-13, 15,17-19	
A	US 5 974 101 A (NAGO HIDETADA) 26 October 1999 (1999-10-26) * column 21, line 10 - line 13 * * column 22, line 52 - line 55 * * column 23, line 29 - line 46 * * figures 6,10A,10B *	1,2,4-6, 17-19	

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04Q
H04L
H04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	19 June 2002	Farese, L

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EUROPEAN SEARCH REPORT

Application Number
EP 01 40 2507

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	SATORU AIKAWA ET AL: "BIT INTERLEAVING TECHNIQUE AS A RADAR INTERFERENCE CANCELLER IN DIGITAL MICROWAVE RADIO SYSTEMS" DISCOVERING A NEW WORLD OF COMMUNICATIONS. CHICAGO, JUNE 14 - 18, 1992. BOUND TOGETHER WITH B0190710. VOL. 4, PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, NEW YORK, IEEE, US. vol. 3, 14 June 1992 (1992-06-14), pages 1482-1486. XP000337953 ISBN: 0-7803-0599-X * abstract * ---	1,17-19	

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The present search report has been drawn up for all claims

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19-06-2002

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